Alcoholism and Industrial Accidents

by

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The study of the causation of industrial accidents in recent years has shown that even when mechanical dangers, such as defective or unfenced machinery, have been removed there is still a very considerable risk of accident arising from the physical and mental characteristics of the individual worker. Various investigators have endeavoured to isolate and analyse the personal factors in the accident risk, and the present article is a study of the difficult question of the relation between the consumption of alcohol and the incidence of industrial accidents. Reliable data are too scanty to justify definite conclusions, but the following survey of the available statistics throws valuable light on the question.

ALCOHOLISM is being more and more recognised as a potent cause of degeneration and poverty in modern society. During the war the necessity of extracting the fullest value from the national resources, economic as well as military, led most of the principal countries to deal with the problem of alcoholism, and since the war the dangers caused by intemperance, particularly to labour and industrial efficiency, have received increasing attention.

Of the many risks imposed upon labour by the organisation and conduct of modern industry, few are more striking than that of industrial accidents. To remedy and prevent this grave waste, not only in human life and limb, but also in productive capacity and money, is regarded as one of the paramount problems of industry.

It has been repeatedly asked whether there is any relation between these two problems of industrial life; in other words, whether alcoholism plays a part in the causation of industrial accidents. The answer generally tends to be in the affirmative. The basis of this contention is to be found in the conclusion of modern industrial psychology that industrial accidents are not primarily due to defective machinery, lack of safety appliances, unfavourable atmospheric conditions, etc. The principal element

in accident causation is the human subject himself. It is the experience and judgment of the worker, his foresight and coolness, his quickness of reaction and freshness of attention, in short, the whole physical and mental condition of the worker, that determine his risks in the present age of movement and speed.

The consumption of alcohol is likely to affect the industrial accident risk because of its influence upon both the physical and psychical state of the workers. It has been proved that alcohol is a drug, and if consumed in excess a poison. Laboratory observation has shown that the use of alcohol, even in comparatively small quantities, affects the brain nerve force, increases reaction time, retards the rapidity and extent of reflex movements, and increases muscular inaccuracies. Moreover, alcohol is cumulative in its deleterious effects on the human body, and a continued and excessive use of it, therefore, alters the state of the tissues of the body, with the effect that the consequences of accidents are considerably aggravated in alcoholic subjects. It is unnecessary here to enlarge on this point, on which medical science is clear. Two leading medical and surgical authorities have summed up the relation of alcoholism to industrial accidents as follows[1]:

(1) By its action on the nerves, alcohol renders an individual more liable to sustain an accident.

(2) By producing a degenerate condition of the body, alcohol renders the processes of repair of injury difficult.

(3) By its action on the heart and reduction of the body temperature, alcohol renders death more liable to result from injury or operation.

(4) Erysipelas and other complications are likely to arise in alcoholic subjects.

The medical evidence is emphatically supported by industrial accident insurance institutions, factory inspectors, and safety men in various countries. By experience of insurance and workshop practice, they have been convinced that alcohol plays an important part in accident causation. The Federal Insurance Office in Germany, after several years' experience, officially invited the employers' insurance associations to combat the use of alcohol among insured persons, and to grant increasing sums of money for this purpose. In compliance with this invitation the industrial associations waged a systematic and consistent campaign against

[1] J. Frank WETHERED and Gordon TAYLOR, in *Accidents in their Medico-legal Aspect* (edited by Douglas Knocker), p. 48. London, 1912.

the use of alcohol, especially among workmen[1]. In the United States, again, where the accident prevention movement has been perhaps more developed than elsewhere, the National Safety Council has attacked the problem of alcoholism on similar lines. There can be no more eloquent witness of the conviction of the American safety men than the " Resolution deprecating use of drinks " unanimously passed at the Congress of the National Safety Council in 1914[2]:

> Whereas it is recognised that the drinking of alcoholic stimulants is productive of a heavy percentage of accidents and of disease affecting the safety and efficiency of working men ; therefore be it resolved that it is the sense of this round table meeting at the Third Annual Congress of the National Safety Council that it places itself on record as being in favour of eliminating the use of intoxicants in the industries of the nation.

Many similar opinions of institutions and experts could be produced, but it is hardly necessary to do so here. General experience and experiment both coincide in showing that the use of alcohol is a serious factor in the production of accidents. The problem of the relation between alcoholism and industrial accidents, therefore, is not so much whether this relation exists, but rather how alcoholism affects accident incidence in practice. The object of this article is to bring together and analyse, from the point of view of the methods employed as well as of the facts arrived at, the chief existing statistical information on this problem.

Statistical Methods

Information relative to the effects of alcoholism upon accident incidence comes from many different sources and is of very varying value. The first task is therefore to discriminate carefully between the different classes of statistics.

The criterion to be employed in any study of the effects of alcoholism is naturally the definition of the various forms of alcoholism. In this respect two distinctions should be made. The first one is between " chronic " and " acute " alcoholism, which is

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[1] Cf. R. Burkhardt : *Die Beziehungen der Alkoholfrage zur deutschen Arbeiterversicherung*, pp. 24-25 and 41-42. Berlin, 1911.

[2] *Proceedings of the National Safety Council, Third Annual Safety Congress* (Chicago, 1914), p. 221.

a medical distinction according to the degree of alcohol consumption. To the former category belong both drunkards properly so called and persons who are in the habit of continually taking large doses of alcohol ; the latter form of alcoholism makes itself most evident in the acute stage of intoxication.

The second contrast, according to the well-known theory of Dr. Sullivan[1], is between " industrial drinking " and " convivial drinking ", which is a distinction according to the place and time of alcohol consumption. By industrial drinking is meant the consumption of alcohol during working hours — in the morning, at the breakfast interval, during the dinner hour, in the middle of the afternoon, etc. — while convivial drinking means drinking during leisure hours. Experience has shown that workmen in certain trades who are cut off from alcohol during working hours often become convivial drinkers. In general, it would seem that industrial drinking tends to develop into chronic alcoholism, while convivial drinking, although it may lead to the same result, is usually more or less spasmodic.

It is evident that the effects of these different forms of alcoholism lend themselves to statistical treatment in very varying degrees. As regards " chronic alcoholism ", which presents the cumulative effects of the consumption of alcohol and often reveals itself unmistakeably, some direct methods of investigation may be employed. What is required is a record of the accident incidence among persons coming under the category of chronic alcoholism as distinguished from other persons. For technical reasons, however, such specific data cannot generally be found in official statistics of industrial accidents, and therefore require special detailed investigation.

The same holds good of the study of the effects of " acute alcoholism ". Drunkenness, being a " human cause " of accidents, remains outside the scope of official statistics, which usually indicate mechanical causes only. Little can be expected even from special investigations. With a few exceptions, drunkenness in general does not bear directly on the question of industrial accidents, for in most industries today the workers are as a rule forbidden to consume alcohol in the factory. It is primarily the statistics of non-industrial accidents that may offer valuable information on this point.

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[1] W. C. SULLIVAN : *Alcoholism ; a Study in Social Pathology.* London, 1906.

It follows from the above that the importance of "industrial drinking" is tending to diminish in modern industry. Before the war this custom flourished in many occupations, and its injurious effects in the production of industrial accidents were generally recognised. The existing statistical evidence in this connection is unfortunately very scanty. Such evidence could be secured only by lengthy experiments, and few individual establishments have undertaken the task.

The most important form of alcoholism today is no doubt "convivial drinking". In this case, however, to determine the influence of the use of alcohol on accidents is a most difficult if not impossible task. It is comparatively easy to ascertain the effect of a mechanical cause of accidents, e.g. unfenced machinery or falling objects, but the mental state of the worker at the time, whether influenced by alcohol consumption or other conditions, such as fatigue, depression, monotony, energy, hurry, confusion, ventilation, temperature, etc., is almost impossible of exact determination[1]. Nearly every writer on the subject has instanced the larger number of accidents on Monday, following alcoholic indulgence during the week-end, and some of them have pointed to the high accident rates during the first hours of the night shift as a consequence of the consumption of alcohol in the evening. An attempt has been made to elucidate these phenomena in official statistics by classifying accidents by days of the week and hours of the day and night. At the first glance, however, such statistics with their crude figures and percentages appear of doubtful significance, unless amplified by further information on accident causation. Fortunately, in a few special investigations this more adequate method has been employed.

When all is said, the investigation of the effects of alcoholism on industrial accidents is one of the most difficult problems in the study of accidents. The alcohol factor is interwoven with the many elements that make up the cycle of accident incidence, and can be disentangled only after careful special investigation. Owing to this inherent difficulty, the statistical methods available are very restricted. For the most part the student must be content with indirect methods by which only the coincidence of facts and the probability of a relation between alcoholism and accidents may be shown. By adequate and skilful use of these methods, however, some evidence may be obtained.

[1] Cf., for example, Boyd FISHER: *Mental Causes of Accidents*. New York, 1922.

Influence of Chronic Alcoholism on Accidents

There has been much discussion among insurance statisticians as to the value of the experience of certain Swiss and British accident insurance companies which has led them to establish special tariffs, with a 10 per cent. reduction in premiums, for total abstainers[1]. Even though the existence of a lower accident risk among total abstainers may be as yet open to question, there are at any rate reasons for assuming, inversely, that the accident risk is higher for persons suffering from chronic alcoholism than that for others.

The character of the industrial accident insurance of today renders statistical proof of this assumption extremely difficult. As insurance is mainly both compulsory and collective, it is generally impossible to take into account, as is done in commercial insurance, the individual risks of the insured person. Whether a drinker or teetotaller, the worker is entitled to the same benefits and represents the same financial liability to the employer and insurance institution. It is therefore necessary to examine the risks of a limited group of persons, and even then the results can be considered trustworthy only if sufficiently large numbers of persons for a sufficiently long period are covered. Such a study has actually been undertaken by one important insurance institution, the Sickness Insurance Fund of Leipzig and district. The well-known mortality and morbidity statistics of this fund, published by the German Federal Statistical Office, constitute the only valuable contribution to the determination of the special accident risk due to chronic alcoholism.

In these statistics the degree of accident risk for drinkers has been calculated as distinguished from the normal or average accident risk under similar conditions; persons were considered as " drinkers " if their insurance cards were marked by the doctor " potator ", " chronic alcoholic ", or " delirium tremens ". With this definition, persons suffering from ordinary occupational or acute intoxication by alcohol were excluded from the group of " drinkers ", which therefore does not include all those whose physical or psychical condition had suffered from excessive use of alcohol. On the other hand, the number of total abstainers

[1] Cf. Alexander Elster: " Alkoholismus ", in *Handwörterbuch der Staatswissenschaften*, Vol. I, p. 212. Fourth edition, 1923.

was so insignificant that it could not be examined separately. The distinction made in the statistics is thus not between drinkers and abstainers, but between known excessive drinkers and the great mass of ordinary consumers of alcohol. In view of this it is probable that the particular features of the statistics relating to chronic alcoholism are somewhat weakened.

The study was limited to the men subject to compulsory insurance, since among other members of the sickness fund, i.e. men voluntarily insured and women, the number of chronic drinkers was not sufficiently large for reliable statistical treatment. The statistics cover the 19-year period from 1887 to 1905. During this period the total number of men subject to compulsory insurance was 952,674. The number of drinkers is given as 4,847. These figures, however, are not the actual numbers of persons, but the total number of membership years of these persons; if a person was a member of the fund for ten years and was treated for chronic alcoholism in one of those years, all the ten years were counted in calculating the number of drinkers given above. It was not possible to find for how many of these years each individual had been a chronic drinker.

In view of the wide scope of the statistics and the careful method employed, particular importance attaches to their results.

It may be mentioned at the outset that the age distribution of members among the drinkers was very different from that of the total membership. The majority of drinkers (62 per cent.) were between 35 and 54 years of age, while the majority of all members (69 per cent.) were between 15 and 34 years of age. Further, the labour turnover was two to three times greater among drinkers than among the total membership; on an average each drinker changed his employment once in 148 days covered by the insurance, and his occupation once in 585 days. In view of the fact that the accident risk is closely connected with the age and experience of the worker, these facts alone strengthen the probability of a high accident risk for drinkers.

The accident statistics of the Leipzig Fund are shown in tables I and II. The first table gives the number of industrial accidents per thousand annual members, thus showing the accident frequency. The second table gives the number of days' sickness caused by the same accidents per thousand members, which may be called the accident severity, although it does not exactly correspond to what is called severity in industrial accident statistics (i.e. the number of working days lost on account of industrial accidents,

calculated according to special time-loss tables, per thousand persons covered). In both tables accidents are classified by the period of the resulting disability and the injured persons by age. It should be noted that under the German social insurance system the sickness insurance institutions, of which the Leipzig Fund is one, pay compensation only for industrial accidents which result in temporary disability involving loss of working time for less than 13 weeks; thus the more serious non-fatal and all fatal accidents are excluded from these statistics.

The number of accidents covered by these tables is 39,793 among the total membership and 564 among the drinkers. The total number of days' sickness covered is 893,846 among the total membership and 13,948 among drinkers[1].

TABLE I. FREQUENCY OF NON-FATAL INDUSTRIAL ACCIDENTS AMONG THE MALE MEMBERSHIP OF THE LEIPZIG SICKNESS FUND, 1887 TO 1905

Age group	Number of industrial accidents per 1,000 annual members, by period of resulting disability					
	28 days or less		29 days to 13 weeks		Over 13 weeks	
	All members	Drinkers	All members	Drinkers	All members	Drinkers
15 to 34	32.2	90.2	7.7	22.9	0.1	4.9
35 to 54	32.1	88.6	13.5	33.2	3.4	6.4
55 to 74	27.1	56.6	17.8	33.0	5.8	11.8
All age groups	32.1	86.2	9.6	30.1	2.0	6.4

TABLE II. SEVERITY OF NON-FATAL INDUSTRIAL ACCIDENTS AMONG THE MALE MEMBERSHIP OF THE LEIPZIG SICKNESS FUND, 1887 TO 1905

Age group	Number of days' sickness due to industrial accidents, per 1,000 annual members			
	Cases lasting 28 days or less		Cases lasting 29 days or more	
	All members	Drinkers	All members	Drinkers
15 to 34	384	1,121	409	1,417
35 to 54	412	1,105	812	1,944
55 to 74	380	804	1,134	2,033
All age groups	394	1,083	545	1,794

[1] K. STATISTISCHES AMT: *Krankheits- und Sterblichkeitsverhältnisse in der Ortskrankenkasse für Leipzig und Umgebung; Untersuchungen über den Einfluss von Geschlecht, Alter und Beruf*, Vol. I, Part E, Appendix; Vol. II, Part A, ch. II; Vol. III, Part E, ch. II. Berlin, 1910.

The two tables leave no room for doubt as to the influence of chronic alcoholism upon the industrial accident risk. It would be a conservative estimate to say that the industrial accident risk is about three times as high among drinkers as among men in general, including ordinary alcohol consumers. It is noteworthy that the particular accident risk of drinkers exceeds the general accident risk especially in the younger age group, i.e. among men between 15 and 34 years of age. Moreover, the excess of the drinkers' accident risk over the general risk is proportionately higher in the group of severe accidents than in that of slighter ones. The severity of accidents to drinkers appears considerably higher than that of accidents in general, as will be suggested by the number of days' sickness. It will be seen that, while the drinkers' accident risk in the group of accidents involving disability for 28 days or less is 2.5 times as high as the general risk, in the group of more severe accidents the drinkers' risk is nearly 3.5 times as high. Here, too, the drinkers' accident risk is most clearly shown in the youngest group of insured men.

To judge from the above figures chronic alcoholism imposes a heavy additional charge upon industrial accident insurance. This additional charge was estimated by the German authorities in 1913 at nearly 32 million gold marks per year.

Influence of Acute Alcoholism on Accidents

Acute alcoholism, or, to use a colloquial term, drunkenness, may be assumed, in view of its influence on the workers' judgment and foresight, to form a cause of industrial accidents. In the ordinary classification used in industrial accident statistics, however, such a heading practically never appears. The reasons for this are easy to understand. It is first to be noticed that accidents due to intoxication are as a rule not considered as compensable industrial accidents in legislation or judicial practice. Such accidents are wholly or partly excluded from the workmen's compensation and accident insurance acts in Denmark, India, Japan, the Netherlands, Roumania, South Africa, Sweden, New Brunswick and Yukon (Canada), Victoria (Australia), and 31 of the American States. In other countries the definition of an industrial accident implies that it must have its direct cause in the employment or work itself if compensation is to be awarded, and this excludes most of the accidents attributable to alcoholic indul-

gence. As a consequence, such accidents are not tabulated in the industrial accident statistics.

Where accidents to which the consumption of alcohol has contributed are covered wholly or partly by the law, it is evidently in the interests of the employer and factory inspectors to avoid this cause of increased accident risk. In modern industry the consumption of alcohol at work, the introduction of alcoholic liquors into the factory, and the admission of men to the factory when drunk are as a rule forbidden. It is, then, clear that industrial accidents directly due to drunkenness are rare in industrial employment.

The definition of the " cause " of an industrial accident is by no means an easy task. Theoretically, every accident is the outcome of a long train of events and can be traced back to some remote cause which is usually some failure of human foresight or insight. In the statistics of industrial accidents, however, only what is called the immediate mechanical cause is taken into account[1]. For instance, if a man stumbles and thrusts his hand into an unfenced gearing which cuts off two of his fingers, the accident is charged to the gearing and not to stumbling. Yet the fact that the worker stumbled may very well be due to his being drunk, without which the accident would not have occurred. It follows that even when drunkenness may have been an important, or even the primary, cause of an accident this is attributed not to drunkenness but to a subsequent mechanical factor.

Despite the difficulty of isolating the alcohol factor among the many causes of accident, certain authors have endeavoured to determine the extent to which drunkenness has contributed to the various classes of industrial accidents. Thus a German author [1] has tried to establish drunkenness as a contributory cause in machine accidents, in accidents caused by animals, by horseplay, brawling or violence, negligence, etc.[2] This may be correct, but definite statements based on such vague material are mere guesswork and have hardly any scientific value.

This is not so, however, in the case of " non-industrial " accidents. Drunkenness is bound to occur chiefly outside regular working hours in the factory, and information on the matter is only likely to be found in the statistics of accidents occurring in the workers' spare time. Such statistics are very rare ; as a rule

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[1] Cf. INTERNATIONAL LABOUR OFFICE : *Methods of Statistics of Industrial Accidents*, pp. 10-12 and 33 ; Studies and Reports, Series N, No. 3. Geneva, 1923.

[2] Dr. K. WEYMANN : *Arbeiterversicherung und Alkoholfrage*, pp. 11 *et seq.* Berlin, 1907.

workers are not insured against accidents occurring outside their employment. The accident insurance system of Switzerland, however, forms an interesting exception. Although, strictly speaking, somewhat beyond the scope of the present paper, a brief account of the experience of the Swiss Accident Insurance Office will be valuable because of the novelty of the statistics.

These statistics tabulate the non-industrial accidents sustained by persons covered by the Federal Sickness and Accident Insurance Act of 1911, classified by cause[1]. Since the number of workers exposed to the accident risk in each group is not given, it is impossible to give frequency rates, but this may be replaced by the rate of compensation cost per case of accident in each cause group. The statistics cover office employees and manual workers of both sexes, and the importance of accidents due to drunkenness probably therefore appears smaller than it is in reality, since this class of accident is comparatively rare among women. The accidents covered are those involving disability for three days or more. There are three groups of non-industrial accidents : (1) those occurring at the home of the employee or worker ; (2) those due to some kind of work outside regular employment ; and (3) accidents occurring during leisure time strictly so called. Accidents due to drunkenness fall on the whole into the third group.

TABLE III. NUMBER AND COMPENSATION COST OF NON-INDUSTRIAL ACCIDENTS, BY CAUSES, IN SWITZERLAND, 1920 TO 1922

Cause	Accidents		Compensation cost	
	Number	Per cent. of total	Total	Per accident
			francs	francs
Motoring	586	0.9	1,158,191	1,976
Drunkenness	407	0.7	518,057	1,273
Brawling	535	0.9	449,422	840
Travelling to and from workplace, walking, general travelling	14,872	24.0	8,151,791	526
Sport, target practice, etc.	7,542	12.2	3,798,167	504
Domestic, agricultural, forestry, and other work in spare time	18,856	30.3	8,064,162	430
Cycling	12,009	19.3	4,988,622	415
Remaining in a house	6,400	10.3	2,366,184	370
Miscellaneous	86	1.4	547,463	—
Total or average	62,074	100.0	30,042,059	484

[1] SCHWEIZERISCHE UNFALLVERSICHERUNGSANSTALT : *Ergebnisse der Unfallstatistik der ersten fünfjährigen Beobachtungsperiode 1918-1922*, table II B. Lucerne, 1924. A full analysis of this report was given in the *International Labour Review*, Vol. X, No. 5, Nov. 1924, pp. 837-853.

It will be noted that the number of accidents due to drunkenness represents only a very small proportion of the total, but it is stated that this is somewhat misleading. The heading " drunkenness " covers only accidents of which alcohol is the sole and certain cause. The Swiss Insurance Office notes that drunkenness plays an important part in many other groups of accidents, particularly in those attributed to brawling, cycling, walks, etc.

The outstanding feature of the table is, however, the extraordinary severity of accidents due to drunkenness. Except motoring accidents, which form a class apart, they are by far the most severe accidents of all, the average cost of compensation exceeding that for all accidents by more than 160 per cent.

This corroborates the evidence given in the previous section that the effect of the consumption of alcohol upon the accident risk is to be found in the increasing severity of accidents more than in their frequency. From the point of view of insurance and safety this is, of course, a most important feature. The Director of the Swiss Insurance Office justly states that " the abuse of alcohol, in particular, plays a very great, it may almost be said a preponderant, rôle in insurance against non-industrial accidents. Accidents due to drunkenness, such as falls, brawling, etc., impose a heavy charge upon the Insurance Office[1]."

Influence of Industrial Drinking on Accidents

The custom of " industrial drinking " is chiefly prevalent among workers who have to make sudden spurts of severe muscular effort, and whose drinking propensities are subject to little control or supervision, such as dock labourers, carmen, quarry workers, building workers, and seamen. There are certain occupations which predispose to or encourage drinking, e.g. the manufacture and sale of alcoholic liquors. Under certain conditions the habit of taking alcohol regularly during working hours is to be found in every kind of industry. Excessively long hours, overtime, Sunday work, excessive speed or pressure, working in overheated atmospheres, etc. are incitements to such drinking. On the other hand, industrial drinking varies considerably from country to country. For instance, it is stated to be comparatively rare among agricul-

[1] A. Tzaut : " La Caisse nationale suisse d'assurance en cas d'accident ", in *Annales de la régie directe*, Nos. 166-169, p. 141. Geneva, 1923.

tural labourers in England, but very usual in Germany. In certain occupations industrial drinking is a regular feature in practically all countries[1].

In Germany this phenomenon has long been regarded as a particularly dangerous one, as evidenced by the action of the Federal Insurance Office and by the campaign organised by a number of insurance associations against industrial drinking[2]. As a result of these efforts the regulations concerning alcoholic liquors were changed in many establishments ; either the introduction of alcoholic liquors into the factories and drinking during working hours were prohibited, or a competitive service of non-alcoholic drinks in the factory was organised. Such changes present excellent opportunities for the study of the effects of industrial drinking upon accident incidence. Other things being equal, a decline in accident rates may be expected to result from such measures.

Statistics on these lines have, however, been compiled by only a few industrial establishments. A standard example of this kind of experiment is supplied by the Ilseder Foundry in the Hildesheim district of Prussia, special statistics for which were published by the Prussian Industrial Councils in their report for 1904. The years under observation were divided into two periods of four years each. During the first period, from 1897 to 1900, the sale of beer by dealers from outside was permitted and was stated to flourish ; there was no control of drinking. During the second period, from 1901 to 1904, beer sellers were excluded from the workshops, but beer was supplied by the management in limited quantities and at cost prices. In addition to this, mineral waters and coffee were sold under cost price. It is stated that during this period the consumption of beer decreased considerably, while the consumption of mineral waters and coffee correspondingly rose.

The results of the statistics will be seen from the table below[3]. For the sake of brevity, the annual figures have been reduced to averages for the two periods, i.e. the periods of " free drinking " and of " controlled drinking " respectively. In calculating these

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[1] On this subject, see W. C. SULLIVAN : *op. cit* ; Edgar L. COLLIS and Major GREENWOOD : *The Health of the Industrial Worker* (London, 1921), pp. 276-278 ; Sir Thomas OLIVER and E. L. COLLIS : "Industrial Alcoholism ", in the *Lancet*, Vol. CCII, No. 5146.

[2] Cf. R. BURKHARDT : *op cit.*, pp. 41-43.

[3] *Bericht der Kg. Preussischen Gewerberäte auf das Jahr 1904*, p. 292. Berlin, 1905.

averages the figures for 1898 and 1902 were not available, but the statistical error resulting therefrom has no bearing on the general result.

TABLE IV. FREQUENCY OF INDUSTRIAL ACCIDENTS IN THE ILSEDER FOUNDRY, PRUSSIA, 1897 TO 1904

Period	Régime of drinking	Average number of workers	Industrial accidents	
			Annual average	Rate per 1,000 workers
1897 to 1900	Free drinking	1,092	145	132.8
1901 to 1904	Controlled drinking	1,508	54	36.0

The statistical methods used in the above investigation were not so elaborate as the problem merited and the material permitted. The accident data include all classes of accidents without even distinguishing between fatal and non-fatal ones; consequently no idea of the accident severity can be formed. But even in their inadequate form these statistics give eloquent evidence of the effect of industrial drinking upon accident incidence. Merely by controlling the sale of beer and inducing the men to consume non-alcoholic drinks, the accident frequency was reduced by 73 per cent. as between the periods of free and controlled drinking; during the period of controlled drinking the accident frequency was reduced by nearly 50 per cent. as a consequence of the successful competition of non-alcoholic drinks with beer.

Similar experiments have been recorded in several other industrial establishments in Germany, but the statistics relating to them are less complete. In this connection, undertakings manufacturing alcohol, especially breweries, present special interest. In these establishments the custom of the management of supplying free beer (*freie Haustrunk*) to the employees was found to contribute greatly to industrial drinking, and it was often stated in the law courts that free drinks were the cause of bad discipline and of many serious accidents. The effects on the accident rate of abolishing free beer are recorded for the Wiesbaden breweries. The statistics cover three years; in the first two years free beer was supplied, while in the third year this was abolished. The accident rate was tabulated for each year.

TABLE V. FREQUENCY OF INDUSTRIAL ACCIDENTS IN THE WIESBADEN BREWERIES, 1901 TO 1903

Year	Régime of drinking	Accidents per 1,000 workers
1901	Free beer	181
1902	Free beer	182
1903	No free beer	127

Thus the system of free beer was responsible for more than 30 per cent. of the accidents to the workers in these breweries.

The injurious effects of industrial drinking upon the industrial accident rate have been generally recognised, not only in Germany, but also in other countries. The result has been, as was mentioned in the preceding section, that industrial drinking has been more and more restricted. During the war this tendency was greatly strengthened[1].

After the war, two countries — the United States and Finland — enacted laws prohibiting the manufacture or sale of alcoholic liquors. One of the effects of this measure has been a substantial decrease, if not the disappearance, of industrial drinking. This should manifest itself among other things in a reduction of the industrial accident rates, but owing to the complicated nature of accident causation and the short period of experience there is as yet little direct evidence of this. In 1923 the International Labour Office, having frequently observed references in safety discussions to the effect of Prohibition in the United States, asked the opinion of the National Safety Council on this point. The reply was to the effect, that on the one hand, safety work had generally been carried so far even before the introduction of Prohibition that no general statement on its effects could be made, but that, on the other hand, " big American firms attribute the great decrease in accidents in their plants, amounting to 68-75 per cent., to the effect of Prohibition ".

[1] In Great Britain, for instance, one of the first steps taken by the Liquor Control Board was to remedy the evil of industrial drinking by establishing industrial canteens. Almost all of these canteens were " dry " and provided a powerful incentive to temperance.

Influence of Sunday Drinking on Accidents

Mention has already been made of the question of " convivial drinking ". Today this form of drinking is perhaps the most frequent source of degeneration of workers, but its effects upon industry are the most obscure.

The most usual method of investigating the effect of " convivial drinking " on accident incidence is to classify accidents by days of the week. The theoretical basis of this method is the following: if workers are addicted to alcohol, they are likely to drink during their leisure time, and above all on Saturday afternoons and Sundays, when they usually also are in possession of their weekly wages. Consequently, if the consumption of alcohol be a cause of accidents, the results of week-end indulgence should be shown in higher accident rates, especially on Mondays.

Before discussing the above reasoning — which seems open to doubt — it must first be ascertained whether the accident rate on Monday actually is higher than that on other days of the week.

It should be noted, first, that the main sources of information on the point are the official statistics of industrial accidents in various countries. For the purposes of these statistics there is no particular object in classifying accidents by days of the week, and the influence of alcoholism has only been offered as a probable explanation of the figures given. While this guarantees the unbiassed character of the statistics, it also accounts for their inadequacy.

The principal flaws in these statistics may be briefly mentioned here. Usually the total number of accidents during the year is simply distributed over the actual days of the week on which they occurred, and percentages (or index numbers, taking the average number of accidents per day equal to 100) are then calculated on the basis of these crude figures. This method is obviously unsatisfactory. Take first the percentage for Sunday. This is normally the weekly rest-day (workers employed in continuous-process industries who work also on Sunday represent only a small proportion of the total), and consequently the accident exposure on Sunday is different from that on other days of the week. The percentage of accidents on Sunday may be much less than on other days, yet the accident risk may be equal or even higher. The incomparability of the figures resulting from this fact could be remedied if the accident exposure on the different days of the week were known, but this is impossible without special enquiries limited to a particular industry or establishment.

On Saturday, too, the accident exposure is usually smaller than on other days of the week, because the hours of work are shorter. Hours however, vary enormously not only from country to country, but also from one industry to another within a single country. If it be known by how much the Saturday hours of work are shorter than the hours worked on other days of the week the Saturday accident figures might be corrected by increasing them by a percentage proportionate to the reduction in hours of work. This method is, however, so laborious that it has very rarely been adopted.

Another and more important point is that of annual holidays. One or two holidays on which no work or only part-time work is done are likely to modify considerably the distribution of accidents between the different days of the week. When only one year is under consideration the figures may be corrected by treating all the holidays of the year as Sundays and omitting them and all Sundays from the statistics. In a study covering a longer period, the influence of variable holidays will neutralise each other, but it should be noted that in many countries there are two Mondays which are always holidays, Easter Monday and Whit Monday. For absolute accuracy the Monday figures should be increased proportionately, but this is very rarely done in official statistics.

With the above reservations regarding the reliability of the statistics concerned, a comparative table is given below showing the distribution of accidents by days of the week according to the official figures published. It should be noted, although it does not influence the general results very much, that the scope of the different statistics is not the same. The following notes show the principal differences:

DENMARK[1]: Accidents in agriculture and forestry reported to district physicians during six months in 1906.

FINLAND[2]: Accidents in manufacturing and building industries involving disability of more than 6 days' duration; average for the period 1898 to 1914.

GERMANY[3]: Accidents in mining, manufacturing, and building industries disabling for more than 13 weeks; average for the years 1897 and 1907 (statistics published decennially only).

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[1] STATENS STATISTISKE BUREAU: *Ulykkestilfaelde i Land og Skovbrug* (Statistiske Meddelelser, Series IV, Vol. 25, No. 3. Copenhagen, 1907.

[2] TEOLLISUUSHALLITUS. *Työssä sattuneet tapaturmat*, 1-12, 1898-1914 (Suomen Vir. Til. XXVI, Työtilastoa, A). Helsingfors.

[3] REICHSVERSICHERUNGSAMT: *Gewerbe-Unfallstatistik für das Jahr 1907*, table 2 (*Amtliche Nachrichten*, 1910, 1. Beiheft, 1. Teil, Berlin.

ITALY[1] : Accidents in manufacturing and building disabling for more than 5 days, for the year 1904.

NETHERLANDS[2] : Accidents in manufacturing, building, and transport disabling for more than 2 days ; average for the years 1915 to 1917.

NORWAY[3] : Accidents in mining, manufacturing, building, and forestry disabling for more than 4 weeks ; average for the period 1896 to 1906.

SWEDEN[4] : Accidents in mining, manufacturing, building, and transport disabling for more than 60 days ; average for the years 1906 and 1907.

SWITZERLAND[5] : Accidents in mining, manufacturing, building, transport, railways, inland navigation, other transport, public utilities, and certain commercial establishments, disabling for more than 2 days ; average for the years 1920 to 1922.

TABLE VI. PERCENTAGE DISTRIBUTION OF INDUSTRIAL ACCIDENTS BY DAYS OF THE WEEK IN VARIOUS COUNTRIES

Country	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Denmark	10.2	17.5	15.0	14.3	14.4	14.5	14.1
Finland	2.8	16.7	16.7	16.0	16.3	16.8	14.7
Germany	2.4	17.1	16.2	15.7	15.9	15.8	16.9
Italy	4.7	16.0	15.6	15.7	15.3	16.3	16.5
Netherlands	1.4	17.4	16.9	16.8	16.0	16.5	15.0
Norway	1.0	16.8	17.4	16.5	16.2	17.0	15.1
Sweden	1.8	17.0	16.9	16.4	16.1	16.8	15.0
Switzerland	1.1	17.2	17.3	16.3	16.3	17.8	13.7

It will be seen from the above table that Monday is much less a *dies nefastus* than is usually assumed in general literature on this subject. The highest percentage of accidents falls on Monday in Denmark, Germany, the Netherlands, and Sweden only, and on Tuesday in Norway, while the statistics for Finland and Switzerland show the highest percentage of accidents on Friday. The high percentage on Tuesday in Norway has been explained by the fact that in this country, at the time when the statistics were compiled, the sale of alcoholic liquors was restricted during week-ends and

[1] *Bollettino di notizie sul credito e sulla previdenza*, Appendix Rome, 1909.

[2] *Ongevallenstatistiek betreffende de Kalenderjaren 1915,1916 en 1917*, table V. Amsterdam, 1922.

[3] RIKSFORSIKRINGSANSTALTEN: *Ulykkesforsikringen, 1904-1906*, table 3 (Norges officielle Statistik, V:99). Christiania, 1909.

[4] KOMMERSKOLLEGII AFDELNING FÖR ARBETSTATISTIK : *Olycksfall i arbete 1906, 1907*, table 10 (Arbetsstatistik, C). Stockholm, 1909-1910.

[5] CAISSE NATIONALE SUISSE D'ASSURANCE EN CAS D'ACCIDENTS : *Rapport annuel et comptes*, 1920, 1921, 1922. Lucerne, 1921-1923.

the workers took the opportunity of the re-opening of the public houses on Monday for alcoholic indulgence, the result of which is to be seen in the high Tuesday percentage.

The Friday accident percentage can in no way be explained by alcoholic indulgence. The question whether this is due to fatigue or speed of production — both these explanations have been suggested — is not relevant to the present discussion. The last days of the week generally show a high percentage, which in several countries exceeds that for the first days of the week. This phenomenon becomes all the more striking if the shorter hours of work on Saturday are taken into account. It is probable that, if the working day on Saturday were as long as on other days of the week, the highest percentage would fall on this day. In an interesting special investigation made on the basis of the Finnish statistics by Dr. Lavonius[1], the figures have been corrected by increasing the average number of Saturday accidents in proportion to the shorter hours of work on that day, i.e. by 24.3 per cent. As a result the percentage for Saturday was 18.3 instead of 14.7. On the other hand, when the Monday figures were corrected for the two fixed annual holidays falling on Monday, this day presented the second highest percentage, 17.3 instead of 16.7.

In general it may be supposed that the daily variations in the accident figures mostly reflect simply the variations in hours worked on the different days of the week. It may be safely stated that " the accidents of the different days that work full time never vary more than 10 per cent. from one another "[2].

This is illustrated by a comparison of the distribution of accidents by days of the week in different industries. Investigations on this point may be made for Finland, Germany, the Netherlands, and Sweden, but it is impossible to find any regular features which would justify definite conclusions. For instance, in Germany (industrial accident statistics of 1907) a number of industries show a particularly high accident rate on Monday; the Monday percentage was 30 in the chimney sweeping association and in the Magdeburg building insurance institution, while it was over 20 in the glass, tobacco, building, and transport associations and institutions. On the other hand, the Monday percentage was below 15 in the South-Western and Silesian iron industry, gas and water

[1] Herman LAVONIUS : " Tapaturmien jakaantuminen viikonpäivien mukaan ", in *Sosialinen Aikakauskirja*, 1918, No. 3.

[2] P. Sargant FLORENCE : *Economics of Fatigue and Unrest*, p. 296. London, 1924. (Quoted from the British Association Report, 1915.)

works, the textile industry of Rhenish Westphalia, the silk, sugar, and clothing industries, and on private railways, as well as in six insurance institutions for the building industry. For Great Britain there are no official statistics, but the British Association Committee on Fatigue in 1915 had before it a large number of accident data for many different industries[1]. The classification of the days of the week on which accidents reached their maximum showed that the maximum fell on Monday in 11 industries, on Friday in 8, on Tuesday in 4, and on Wednesday and Thursday in 3 industries each (Saturday and Sunday figures were ignored).

But even in cases where Monday has the heaviest accident rate it is not correct to interpret this as solely due to alcoholic indulgence during the week-end. Recent studies in industrial efficiency have shown that Monday is a bad day from the point of view of output. This is generally explained by the lack of the so-called " practice efficiency ". During the week-ends, when the worker is absent from work, he forgets to some extent the operations which are ordinarily performed quickly and well as a result of practice. On Monday he has to re-learn these operations before the old efficiency can be regained[2]. Further, an American statistician has suggested that changes of occupation generally occur at the end of the week, so that the new work is begun on Mondays[3]. How far this is correct has not been established, but if there is any truth in the suggestion it is very pertinent, as labour turnover, i.e. the fluctuation in the personnel of an establishment, and the inexperience of workers resulting therefrom exercise a striking influence upon accident frequency. In a study of accidents in the American metal trades, the average number injured per day after beginning work on a machine was found to be as follows[4]:

First day	460
2nd day to end of 1st week	83
2nd week to end of 1st month	17
2nd month to end of 6th month	4
7th month to end of 1st year	1.6

[1] BRITISH ASSOCIATION: *Report*, 1915, p. 283.

[2] Cf. A. Stanley KENT: " The Monday Effect in Industry ", in *Journal of Physiology*, Vol. 50, 1916.

[3] I. M. RUBINOW: *Social Insurance*, p. 79. New York, 1913.

[4] UNITED STATES: *Report on Conditions of Women and Children Wage Earners*. Vol. XI: *Employment of Women in Metal Trades*. Senate Documents, No. 645, 61st Congress, Second Session.

These figures show a very great excess of accidents on the first day on the machine; if accident rates had been calculated the excess would have been still more striking.

The inferences to be drawn from the foregoing are, first, that the distribution of accidents over the days of the week shows such irregular and small real variations that it is difficult to draw any definite conclusions from it, and, secondly, that even when Monday shows a higher accident incidence than other days this may be due not only to alcoholic indulgence, but also to the partial loss of practice efficiency, and to the fact that new inexperienced men usually begin work then.

In view of this somewhat negative result, a special enquiry conducted in Great Britain during the war merits particular attention. The investigation was made by Dr. Vernon, on behalf of the Health of Munition Workers Committee, in large munition factories during the years 1915 to 1917[1]. The investigator had an excellent opportunity of studying the problem of alcoholism and industrial accidents. The sale of alcohol was gradually restricted during the years of the enquiry, and the general sobriety of the nation increased considerably; the greatest change in this respect occurred in April 1917[2]. There is no doubt that the workers covered by the enquiry were affected by these facts. Another factor influencing the alcohol consumption of the workers was the different length of the working day. In 1915 and the beginning of 1916 the day-shift workers were kept at the factory until 8.30 p.m. so that they had little opportunity, and probably little inclination, for drinking after work was finished. On Saturdays they stopped work at 5.45 p.m. and on Sundays at 5 p.m.; as their wages were paid on Friday afternoon there was considerable temptation to indulgence at the week-end. From the beginning of 1916 onwards work stopped at 6 p.m. on all days of the week and Sunday was free.

In view of the above conditions three statistical periods were distinguished. The first was the " fatigue period ", from November 1915 to January 1916, the second the " intermediate period ", from February 1916 to April 1917, and the third the " reduced alcohol period ", from April to December 1917.

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[1] Ministry of Munitions, Health of Munition Workers Committee: *An Investigation of the factors concerned in the Causation of Industrial Accidents*, by H. M. Vernon, p. 29. Memorandum No. 21. Cd. 9046. London, 1918.

[2] The total amount of alcohol actually consumed fell to 74 per cent. of the pre-war amount in the beginning of 1917, and to 23 per cent. of that amount from April 1917 onwards. Similarly, convictions for drunkenness decreased in 1917 to one-third and one-fourth of pre-war figures.

The results of this exceedingly careful investigation are shown in the following table giving the daily variation in accidents (cuts) as expressed by percentages. The average number of accidents per day is made equal to 100, and consequently the average number of accidents per week is taken as 700 when all days of the week were worked, and 600 when Sunday was free. The figures for Sunday in the first period (when only 8 hours were worked) have been multiplied so as to make them comparable with other figures.

TABLE VII. DAILY VARIATION IN ACCIDENTS AT A BRITISH FUSE FACTORY, BY SEX OF WORKERS, 1915-1917

(Average number of accidents per day = 100)

Day of week	Fatigue period		Intermediate period		Reduced alcohol period	
	Men	Women	Men	Women	Men	Women
Sunday	78.0	82.7	—	—	—	—
Monday	122.4	115.2	92.7	106.6	110.8	107.4
Tuesday	107.4	105.8	100.9	95.9	99.5	96.1
Wednesday	109.2	93.4	100.7	103.3	98.2	100.1
Thursday	87.6	97.5	106.5	100.5	95.4	101.2
Friday	83.1	84.6	102.2	104.3	92.1	101.2
Saturday	112.2	120.7	96.9	89.4	104.0	94.0
Total	700	700	600	600	600	600
Actual number of accidents covered	660	1,145	2,304	2,426	1,333	1,507

It will be seen that the number of accidents varied in a marked weekly cycle, but there is a great difference in this respect between the " fatigue period " and the two subsequent periods. During the first period there was a comparatively high maximum on Monday, especially among the men, and the figures sank gradually to a minimum on Friday which was 32 per cent. lower among men and 27 per cent. lower among women. Then they shot up again 35 and 43 per cent. respectively to a fresh maximum on Saturday. This cycle suggests that many of the fatigued workers indulged themselves on Saturdays and Sundays, the only days on which there was an opportunity for it. The comparatively low figures for Sunday are explained by the fact that there were more absentees and more slackness on Sundays than on other days.

The accident cycles of the " intermediate period " show no sign of increase on Saturdays and Mondays ; the maximum for the men falls on Thursday and for the women on Monday, but these

maxima differ very slightly from the median. According to Dr. Vernon this is due to the fact that the workers, now released at 6 p.m. every afternoon, no doubt spread their alcohol consumption more evenly over the week.

The " reduced alcohol period " also shows very slight variations in the weekly cycle of accidents. Contrary to what might theoretically be assumed, however, the maxima again fell on Monday, and the men's accident curve shows a steady decline until Friday, as in the first statistical period. The variation is nevertheless small, the drop from Monday to Friday being only 17 per cent. The women's accident cycle reaches its minimum on Saturday. In view of the conditions of work in the factory concerned, it is uncertain whether these changes from the previous cycle are connected with alcoholism, but it may be noted that the public houses, during this period of beer shortage, tended to reserve their supplies chiefly for week-ends.

Influence of Evening Drinking on Accidents

One of the most interesting points in the scientific study of accidents is the influence of industrial fatigue. Many committees and students, especially in Great Britain, France, and the United States, have in recent times attempted to shed light on this difficult question[1], but up to the present the data secured are not sufficiently extensive to justify final conclusions. The usual method of study has been to analyse the hour-to-hour incidence of accidents. This method also provides an opportunity for studying the influence of alcohol consumption upon accident incidence.

The use of alcohol may be assumed to have an opposite influence on hourly incidence from that of fatigue. Other things being equal, the effect of fatigue should be that the accident rate rises as the work goes on. If, on the other hand, accident incidence is influenced by the use of alcohol (before beginning work), the accident rates should be at their maximum during the first hours of work and then fall progressively. This contrast, however, can be made only for night work. A man working during the day who drinks is likely to do so in the evening before going to bed, and unless he has drunk excessively the immediate effects of alcohol

[1] Cf. *International Labour Review*, Vol. X, No. 5, Nov. 1924, pp. 729-758: "The Forty-Eight Hour Week and Industrial Efficiency", by P. Sargant Florence.

will be hardly perceptible the following morning. But a man working on the night shift will be likely to go to bed promptly in the morning and then, waking in the evening, drink before the shift begins, and come to work under the immediate influence of alcohol. During the night the workers, as a rule, have no opportunity of obtaining liquor, and any effect of alcohol would be shown by higher accident rates during the first spell, and a falling rate subsequently.

The problem of night-shift accidents has very rarely been studied from the point of view of the effects of alcoholism, and many of the statistics concerning the distribution of accidents by hours of the day and night are therefore useless for the purposes of the present study. It is to be regretted that many excellent studies of industrial fatigue have neglected the night shift altogether. The most important point is, however, that generally in statistics of hour-to-hour accident incidence no idea of the accident exposure is given. Without such information the statistics are of very doubtful value. When, for instance, the German statistics show that of all night-shift accidents (between 6 p.m. and 6 a.m., in four spells) 53 per cent. on the average occur in the first spell (6 to 9 p.m.), this may be simply because there are more workers on duty then, especially day workers doing overtime. The same applies to most of the official statistics, and it is needless to dwell on this point further.

Since it would be too laborious to record the accident exposure together with the accident incidence from hour to hour, certain other methods have been tested with a view to determining the influence of alcohol on this phenomenon.

The United States Bureau of Labour Statistics has investigated this point in the iron and steel industry. In a group of steel mills there was a record of the distribution of accidents through the hours of the day and night and hourly output over a period of years. Table VIII shows the principal figures[1]. The accident incidence is shown by frequency rates, i.e. the number of accidents per thousand full-time workers for each hour, and output is shown by average hourly tonnage for the same periods. Thus the accident frequency may be compared with the intensity of work.

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[1] UNITED STATES BUREAU OF LABOUR STATISTICS: *Causes and Prevention of Accidents in the Iron and Steel Industry, 1910-1919*, by Lucien W. CHANEY, p. 188. Bulletin No. 298. Washington, 1922. The numbers, being taken from a graph, are not exact to the last figure.

TABLE VIII. HOURLY ACCIDENT RATES AND OUTPUT DURING THE NIGHT SHIFT IN AN AMERICAN STEEL MILL

Hours of night shift	Hourly rate of accidents per 1,000 full time workers	Average hourly tonnage
6–7 p.m.	18.0	345
7–8	17.7	365
8–9	18.2	380
9–10	18.2	390
10–11	16.5	368
11–12	12.2	375
12–1 a.m.	10.9	383
1–2	16.8	380
2–3	17.6	390
3–4	13.4	393
4–5	14.1	405
5–6	13.1	465

It will be seen from the above table that the accident rate was at its maximum during the first hours of the night shift (from 8 to 10 p.m.), then fell until 1 a.m., and varied irregularly from this hour until the morning, without reaching the high figures of the first spell. Output, on the other hand, rose almost continuously from the evening until the morning. It appears, therefore, that the accident rate was not influenced by fatigue but, on the contrary, by the mental state of the workers, in which alcoholic excess may be assumed to have played a part.

The influence of alcohol is only presumed in the above case. Another study which bears directly upon the question of the use of alcohol has been made by the same Bureau. In a large steel plant it was found that the night accident rates were higher than those of the day, and, since the supervisor of labour in this plant had kept detailed records of disciplinary action for drinking, the influence of alcohol could be determined with some degree of certainty. The following table shows, for the day and night separately, the number and rate of cases of disciplinary action in this plant during a period of years[1].

[1] *Ibid.*, p. 184.

TABLE IX. DISCIPLINE FOR USE OF ALCOHOLIC INTOXICANTS IN A LARGE AMERICAN STEEL PLANT, 1907-1913

Year	Number of workers		Number of cases of discipline		Discipline rates per million hours exposure	
	Night	Day	Night	Day	Night	Day
1907	1,897	5,688	41	26	7.1	1.5
1908	1,129	3,446	44	11	12.7	1.1
1909	1,647	4,568	40	6	8.1	0.4
1910	1,998	5,644	47	12	7.8	0.7
1911	1,559	4,215	43	18	9.2	1.4
1912	2,094	5,302	28	28	4.5	1.8
1913	2,003	5,559	33	19	5.5	1.1
Total	12,326	34,422	276	120	7.5	1.2

The above table shows clearly that the night discipline rates were very much in excess of those of the day. Since the enforcement of rules by the management was equally strict by day and by night, it is evident that violation of rules sufficiently pronounced to involve penalties was about six times more frequent at night. This fact was attributed by the management of the plant to the effect of drinking either in the evening just before coming to work, or during working hours, as alcohol could be smuggled into the plant more easily by night than by day.

It is noteworthy that the day-shift discipline rates remained about the same throughout the period covered, but that the corresponding night rates decreased markedly, from 7.1 and 12.7 in 1907 and 1908 to 4.5 and 5.5 in 1912 and 1913. It is also stated that there was a more rapid reduction in night accident rates than in the corresponding day rates. It may then be assumed, with a high degree of probability, that the night drinking of the workers had a direct and unfavourable bearing on the frequency of accidents.

The British Health of Munition Workers Committee also made a special enquiry on this point. On behalf of the Committee Dr. Vernon tabulated the hour-to-hour accident incidence during 1916 and 1917 at the fuse factory mentioned in the preceding section[1]. It will be remembered that during this period the restrictions upon the sale of alcohol became much more stringent. The workers were probably affected by this forced decrease in drinking in

[1] H. M. VERNON : *Industrial Fatigue and Efficiency*, p. 200 ; and HEALTH OF MUNITION WORKERS COMMITTEE : *op. cit.*, pp. 27-29.

the same manner as the nation in general. If there be a relation between drinking and accident frequency the night accident rate especially might be expected to have fallen from 1916 to 1917.

The results of the enquiry are shown in table X. The night-shift accidents (cuts) were grouped in three statistical periods, and in each instance the hourly number of accidents in the third spell of work was taken as the basis of comparison, equal to 1.0. The accident rates were tabulated separately for men and women.

TABLE X. RATIO OF NIGHT-SHIFT ACCIDENTS IN A BRITISH FUSE FACTORY, 1916-1917

Statistical period	Actual number of accidents		Ratio of accidents					
			Men			Women		
	Men	Women	First spell	Second spell	Third spell	First spell	Second spell	Third spell
Feb. to July 1916	1,125	1,085	1.9	1.0	1.0	1.6	1.2	1.0
Aug. 1916 to Mar. 1917			1.5	1.5	1.0	1.4	1.3	1.0
April, to Oct. 1917	847	819	1.4	1.0	1.0	1.4	1.2	1.0
Mean	—	—	1.6	1.2	1.0	1.5	1.2	1.0

Thus the accident ratio was at its maximum during the first spell among both men and women for all the statistical periods. The principal point to be noted for the present purpose is the decrease in the accident rate for the first spell during the three statistical periods as compared with the corresponding rates for the other spells. This decrease is very marked among the men. In the first statistical period the first-spell rate was 90 per cent. higher than in the second and third spells, while the corresponding percentage was not more than 40 in the " reduced alcohol period ". In other words, the accident incidence in the first spell tended to decrease when the general volume of drinking decreased. In the figures for accidents to women there is also an excess in the first spell, but, as the mean values show, the reduction in the proportion of the accidents was much smaller among women, which is in accordance with their greater sobriety[1].

[1] This is illustrated by the fact that at that time the number of convictions for drunkenness was three or four times as great among men as among women.

These investigations thus confirm in a remarkable manner the general experience gained during and after the war, that restrictions on the sale of alcohol and an increase in the general sobriety of the nation have a favourable repercussion on industrial accident rates.

In the preceding sections the various aspects of the effect of the use of alcohol upon accidents have been studied in some detail. It will be realised that, although the existence of this effect has been established by laboratory investigations as well as by experience in safety work, statistical identification of the harmful influence of alcohol is an exceedingly difficult matter. The causation of accidents is so complicated that the influence of what may be called the human causes is often completely masked.

The results of the critical examination of methods tend to show that some of those hitherto employed are of rather doubtful value. The study of the percentage and rates of accidents directly due to "drunkenness" or of the distribution of accidents by days of the week and hours of the day produces little valuable information. It is only by completing this kind of statistics by exact details and collateral information on other facts secured by experimental methods that progress has been and may in future be made in studying the relation between alcoholism and industrial accidents.

It follows from the above that analysis of existing statistics has not produced a final and satisfactory solution to the problem. The evidence presented forms a very heterogeneous body of facts referring to different countries, different periods, and different conditions. The general principles have not, however, been entirely lost sight of, and in conclusion some of these principles may be summed up.

(1) Chronic alcoholism, which can be diagnosed with a high degree of certainty, appears to be a very potent cause of industrial accidents. Persons medically certified as excessive drinkers have been found to be about three times more liable to accidents and to injure themselves much more seriously than other persons, including ordinary drinkers.

(2) Acute alcoholism or drunkenness does not at present appear to be an important direct cause of industrial accidents owing to the reduction in industrial drinking. The effect of drunkenness can be determined only in respect of accidents outside

working hours, and in this respect it has been found that drunkenness is directly and solely responsible for a number of particularly severe accidents and possibly contributes indirectly to about one-fourth of the accidents to workers in their spare time.

(3) Industrial drinking has been found to increase the accident risk; by merely controlling the sale of liquor in the factory or by stopping the supply of free beer, accident rates have been decreased by 30 to 70 per cent. Managements and official inspectors have thus been increasingly led to forbid workers to enter the factory when intoxicated, and to prohibit drinking during working hours.

(4) Convivial drinking seems to be the most usual source of the harmful effects of alcohol consumption. It is, however, extremely difficult to determine its precise influence on accident incidence. Taking first the effect of Sunday drinking, a well-known practice, it can hardly be disentangled from other causes rendering Monday work less efficient and more hazardous than other. A British experiment comparing the accident rates on Mondays during the periods of free and restricted sale of alcoholic liquors does, however, furnish proof in support of the theory that the use of alcohol is one of the factors in the Monday accident risk. Secondly, the effect of regular evening drinking has been shown in the particularly high accident rates in the first spell of the night shift, a result only to be explained by the mental condition of the workers, which is certainly influenced by the use of alcohol.

Industrial accidents constitute one of the heaviest burdens on modern industry and labour alike. Accident prevention, therefore, is an indispensable phase in the great effort to preserve national resources. In this effort the injurious influence of alcohol cannot be ignored. As a prominent American safety man, Mr. W. H. Tolman[1], has put it, "it is to the interest of both the chief of the industry and the workman to fight with all possible means against this redoubtable enemy, alcohol ".

[1] William H. TOLMAN and L. B. KENDALL: *Safety*, p. 33. New York and London, 1913.